

CENTRAL HARDWOODS: WHAT WE KNOW,

WHERE DO WE GO¹

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Abstract.--An assessment of the status of management technology for central hardwood forests shows that practitioners have much information to prescribe for multiple-resource uses. However, guidelines for practical and extensive treatments are lacking for some forest types and sites. Additional research is needed in many areas including more long-term forest processes research.

INTRODUCTION

The purpose of my presentation is to give you my perspectives on (1) where we stand on management techniques for central hardwoods and (2) what we need to do to fill gaps in our knowledge. My comments include views developed the past 2 years while helping prepare the publication, Central Hardwood Notes (In press), a review of the Proceedings of the Central Hardwood Forest Conference VI (1987), and, of course, my experience which covers 40 years as a research silviculturist and a research administrator from Missouri to Washington, D.C., with stops in between. One of those stops included participating in the First Central Hardwood Forest Conference. Finally, I will share some of my specific concerns about research priorities, solving practical problems and technology transfer.

WHAT WE KNOW ABOUT MANAGEMENT

The Research and State and Private Forestry Branches of the USDA Forest Service gave me an opportunity to participate in a unique cooperative project called Central Hardwood Notes. The concept was to bring together the very scattered expertise on central hardwood management through a series of short, practical Notes. This first attempt includes 85 Notes and nearly 100 authors including practitioners and researchers. We likely overlooked some important subjects but oversights and changes can be easily accommodated

through additions and revisions as new information becomes available. Since I reviewed all of the papers, I was exposed to the state-of-the art by a large number of specialists. You will hear more about this project in a later paper.

We have a great deal of technology that can be used to improve the productivity and usefulness of central hardwood forests. The Central Hardwood Notes should be very helpful to practitioners when dealing with a wide variety of resource problems and opportunities. Yet there are some technical areas where we do not have enough definitive information to do a better job, even after more than 50 years of research. But I don't think we have to apologize for our progress considering the efforts expended on the central forests and their inherent complex diversity and broad ecological gradients. We still need more specific information on probabilities of success, and we need specific guidelines for extensive, low cost, treatments. In many cases we do not have adequate data, experience or validation, but I am convinced that we could be more aggressive in interpreting and synthesizing for practical application. We are too conservative. That also applies to some of our scientific reporting. The following comments on the status of our practical knowledge relate only to those general areas covered by the Central Hardwood Notes.

WHAT WE KNOW

We now have a good, general understanding of alternatives for silvicultural systems and how they are likely to meet the various needs of landowners. This information is based on many years of research and experience. The consequences of different kinds of harvest cuttings are generally understood, but our ability to shape future stands in some forest types is limited by lack of ecological knowledge, economic reality and failure to apply what we know. We know when it is safe to

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cut, but we are not sure what to do when it is not. So we wait. And we still need more practical information on how and when to apply the shelterwood and selection systems and how to manage mixed hardwoods and the bottomland types.

Some of the important ecological and silvical characteristics of the different forms of natural hardwood regeneration are defined for most major species. Field foresters must have and understand this kind of basic technology to prescribe treatments. Guidelines to define adequate advance oak reproduction are especially helpful. Unfortunately, the guidelines are based on Missouri data, and they need to be validated and/or modified for other areas. We need similar regeneration guidelines for other species. After many years of research, theoretical prescriptions to establish strong advance oak reproduction remains unproven.

Prescriptions for planting pine and hardwoods have improved a great deal in the past 30 years. The importance of planting site evaluation, planting methods, stock care, stock quality, and weed control are well known by research and are all important to success. Unfortunately, when it comes to practice we do not do as well as we should in applying what we know. Survival rates are too low and too many off-site plantings fail. We have learned a lot about planting black locust (Robinia pseudoacacia L.), black walnut (Juglans nigra L.), yellow-poplar (Liriodendron tulipifera L.), northern red oak (Quercus rubra L.), and eastern cottonwood (Populus deltoides Bartr. ex Marsh.), but we still need convincing research for other hardwoods. All researchers agree--"plant large seedlings"--but they don't tell you how big is large. I know specific data are around somewhere; I helped collect a lot of it.

The general importance of site quality and how to measure site index is well established in central hardwoods. To avoid costly mistakes, every practitioner must understand the relation between quality sites and quality production of forest resources. Site classification systems to improve management for multiple-forest resources on large properties are just starting to be developed for parts of the region.

Technology for growth and yield estimates has advanced rapidly with the advent of computers. Old and new data bases in this forest science area have produced a solid foundation to improve inventory estimates and make projections for some forest types. There are some basic data gaps to be completed, and we still need reliable ways to predict quality changes.

There is a large body of information on the principles and practice of managing hardwood stands. Past research has shown what kinds of responses to expect from intermediate cutting in different aged stands from saplings to mature trees. Release cuttings in very young stands to improve composition, growth and quality is risky. Responses in older stands are more pre-

dictable and some improvement cutting can be good investments. Some excellent guidelines are available for release, weeding, thinning, pruning, and managing for high quality trees. Research on fertilization has been limited and the potential for practical application is uncertain.

Economics and markets are key elements in the future of central hardwoods. We have some guidelines and advice about making decisions on forest investments. We even hear good news now and then about new and expanding markets for low-quality material. But there is a very large volume of presently unmerchantable material taking up valuable growing space that needs to be removed.

Many agents damage hardwood trees: insects, disease, fire, logging, grazing, and perhaps air pollution. We have some good information on things to do and not to do for some of these agents. For others, such as gypsy moth, we may never have easy solutions. We can certainly do a much better job minimizing damage to soils and residual trees during logging. Experiences in Europe and in the eastern United States strongly suggest that the central hardwood forests should be given high priority in future air pollution research.

Wildlife is often given as a primary reason for owning hardwood forest lands. So forest practitioners need to be able to prescribe treatments to favor both wildlife and timber. There are many treatments that can be made in stands of various ages to improve wildlife habitat. But too few of the prescriptions made by wildlife specialists seem to consider forest practices. And too few prescriptions made by forest management researchers consider wildlife needs. Since managers must make prescriptions that include several resources, they need reliable research results where timber, wildlife, water, and other resources were considered in the design, treatments, and outputs. While multidisciplinary research is certainly not a new concept, there seems to be a resurgence of interest in making it work.

If someone is interested in enhancing recreational opportunities, there are some excellent principles and guidelines to follow. The same is true for owners and managers who want to present a natural appearing landscape for themselves and the viewing public. Suggestions for ameliorating the visual impacts of forest cutting practice make good sense, but we need to see some demonstration of how to get practical technology into use.

Research has provided the basic understanding of hydrologic processes and how water production and quality are influenced by forest practices. We have excellent guidelines on how to protect forest soils and water quality during various kinds of forest operations. Forest roads can be constructed and used with minimum erosion. The impacts of forest grazing are well known by water specialists. The pressing problem in forest hydrology is to better use the information we have

to convince forest owners, loggers and farmers to protect watershed values.

DIRECTION OF CURRENT RESEARCH

When I saw a copy of the Sixth Proceedings of the Central Hardwood Forest Conference, I was impressed. I was impressed by how big it was compared to the First Conference. I read the whole thing--all 526 pages. I started out reading only a few papers, but they turned out to be so good I decided to "evaluate" the quality of all the papers. I classified each paper as to whether or not it contained new information. Obviously, I am not an expert in all the technical areas involved, so my estimate was probably conservative. I judged that 80 percent of the papers contained new and useful information for me. That is excellent and demonstrates good work on the part of the scientists and Conference organizers. However, if I was right in my assessment, research budgets could have been extended by 20 percent by more careful problem selection. Simplistic, but I am sure many of you have mentally made these kinds of observations at conferences you have attended.

I liked the general format of the Proceedings, especially the invited papers and keynote. Obviously, they were designed to be provocative and to expose the participants to emerging issues. I believe these Conferences are worthwhile and serve a number of good scientific purposes from peer review to exhilaration and enjoyment. They are essential for the process of scientific scrutiny to improve future research and development.

Having said that, it is my purpose to make some observations, express my concern, and give some opinions on the needs and directions for better hardwood research.

First, I will continue with some observations developed during the Central Hardwood Notes project, my review of the Sixth Proceedings, and of course the bias I have developed through experience and misadventure.

Forestry research reporting is getting better. I am not sure who is responsible, but in my experience authors, reviewers, and editors are all doing a better job. This is reflected in Proceedings, Journals, and Technical Papers. Yet there is room to improve both technical content and readability. We need better research reporting to improve the acceptance of results by peers and users, to be more competitive for research funds, and to get paid more.

There is still a general tendency to use too many words, include unnecessary information, and be indirect. While proper qualification is essential for scientific reporting, over qualification tends to weaken conclusions and mystify readers. Overuse of citations is burdensome and takes up valuable space. Cite new material and authoritative review articles where possible. Over-citing yourself is hazardous unless you are in a very narrow line of research. Too many authors on

a report tends to weaken scientific accountability and credit--footnotes are often more appropriate. Peer reviews are many times cursory, and this is often the result of overusing the "buddy system". Good, constructive reviews make big improvements in manuscripts, but they take valuable time. Be prepared to reciprocate.

I don't want to leave you with the idea that I think all research reporting should be how-to-dos. Scientific reporting is essential to the development of knowledge in any science. My favorite story "on being scientific" is one I tell on myself. Probably my most original research was to clearly demonstrate for the first time that endotrophic mycorrhizae have a beneficial effect on tree growth. I wrote a brief article and submitted it to a new science journal in forestry. They could not use it because it was obviously aimed at foresters and tree planters. So I revised it, made it sound more scientific, and it came out in AAAS's Science with a worldwide audience.

We need to make research problem selection a more rigorous process. There are lots of valid considerations, but the bottom line for both basic and applied research should be who cares? and why? We also need to talk to users, extension specialists, and other agencies before we design studies to be sure that potential results can be directly translated into prescriptions for action. This is a compelling reason for having technology transfer a formal part of the study plan.

Fred Haeussler, past president of the Society of American Foresters and Land Manager for a large forest industry, laid out his concerns for "Application Challenges" rather bluntly in Rochester, New York (1988). Fred said, "Researchers, extension specialists and forest managers don't communicate as well as they should. They don't coordinate their efforts as well as they should. They don't work together in close harmony with joint goals and objectives." He believes there needs to be closer, more open and constructive selection of research priorities.

If a major conclusion is "more research is needed", show why more resources will provide some useful technology. We often fail to point out the practical significance of research results. Many hardwood researchers are too modest about their research; maybe not all of them but at least some of them. Depending upon the audience and outlet, we need to be more aggressive in suggesting how to use new information even if the results are short term, preliminary, or basic in nature.

Sometimes we forget or ignore lessons from the past and do research where it is convenient, not where it is proper. If you do research on artifact sites, you will get artifact results. Black walnut studies on thin, poorly drained soil will produce thin, poor results. After all, we have been hearing off and on since at least 1878 that walnut needs deep, rich soil (Hough 1878).

The publication Research Priorities for Eastern Hardwoods (McLintock 1987) is a definitive source of information on research needs for central hardwoods. It includes priority ratings at the problem area level. It is comprehensive and it is good. Many of you provided input. All hardwood researchers should carefully consider these recommendations when selecting new study areas. Naturally, there are other factors you must consider when setting priorities, such as expertise, support facilities, cooperators, funding levels, time spans, and assignments. Never be timid about expressing your ideas about research priorities after objectively considering the factors and the opinions of others. In my experience, creative ideas are scarce and are rarely squelched.

The same rationale applies to the misapplication of existing technology. All too often we see mistakes by people who should know better. I was asked to look at a bottomland walnut plantation that was failing. The soil scientist said he had taken several soil cores on the site. But he didn't get far enough off the road and the bench it ran on. When we got to the site and opened the car door I knew the answer. You could smell "crawfish land" and you didn't need a lot of soil cores to know what was in the soil profile.

There is no need to improve on McIntock, but I would like to share some of my personal concerns about funding, priorities, and the future of the hardwood resource.

I heard an estimate that the amount of research in the United States more than doubled from 1976 to 1986. In sharp contrast, the number of forest scientists decreased substantially during this period. Giese (1988) traces the decline in funding during the past 10 years and calls forestry research "An Imperiled System." Realistically, other priorities were judged to be more important than ours. We simply did not compete. We can and must do better in demonstrating needs, capabilities and opportunities for better returns on investments in forest research. We need to be more aggressive and more urgent about some of our high priority problems.

In the world race for leadership in biotechnology, forestry is getting off to a very slow start. There are valid reasons why most of the support for this kind of research is put in such areas as medicine and food. But there are exciting possibilities in trees, and we need to find ways to capitalize on this developing technology.

Do we have an imbalance between short-term and long-term research? I think we do, and it is leading to serious problems. First, both kinds of research are essential in developing appropriate alternatives for the management and use of forest resources. A lot of short-term research has provided us with a good understanding of the silvics of major tree species. We must continue to learn

about other species as well. In the past we did not overlook long-term research, but it took a lot of resources and we took a lot of shortcuts. In fact, some long-term research is more accurately described as case studies. The trouble with case studies is that forest stands and situations are dynamic, and they change and case studies become artifacts of forests past. But we have learned a lot from case studies, and we will continue to learn from them. Fortunately, we still have some well-designed long-term research that is still technically active. But with the pressure on research budgets for the past 10 or more years there have been a lot of changes made in the status of various Experimental Forests and long-term research projects. I do not question the wisdom of all the decisions that had to be made, but I suggest that we must find ways to adequately maintain and significantly expand long-term research to develop in-depth treatment-response data sets. We need to make a better case for the usefulness of interim results in long-term research. We have some excellent examples where this was done, but we also have examples where we were not aggressive enough.

Researchers and especially research administrators always say we need more research, which means more money. Why more long-term research? We have reached a point where we must pay more attention to forest systems and forest ecological processes if we are going to find dynamic solutions to dynamic problems. For example, we have yet to resolve a number of important questions for different silvicultural systems including uneven-aged systems. If we do not do more substantive long-term research we will continue to recycle research, reinvent the wheel, and relearn what we already know. We do too much of that now. Let me give you a real example--oak regeneration.

Korstian (1927) and other early American writers gave us the clues to oak regeneration--advance reproduction. The prescriptions for cutting were European but essentially untested in this country. Not to worry, there is plenty of oak in the understory and the overstory. Ivan Sander and I summarized a lot of long-term research in the late 1960's and took a close look at what kind of reproduction we were getting. Not to worry, most of the time we were getting enough oak. But the closer we looked the more exceptions we found. We now believe that there will be more and more exceptions as the stands continue to change dynamically as a result of some dramatic changes in land use. So we know advance oak regeneration is important but we don't know for sure how to get it. Richard Watt and I summarized the collective wisdom of oak researchers in 1971 (Clark and Watt 1971) and proposed how to reproduce oaks without having actually done it. Our recommendations still sound good. In the meantime, Ivan Sander and associates have continued their long-term research to find out the facts. They have generated a lot of basic information and some practical guidelines, but in their expert opinion we still must continue long-term research on the oak regeneration process. I believe them.

All of you oak researchers and managers remember this: oak regeneration is a long-term process and not an event. Problems in oak regeneration are discussed in recent publications by Mills, Fischer, and Reisinger (1987); Coder, Wray, and Countryman (1987); and Crow (1988).

With the technology now available for data collection, storage, summary, and retrieval, the costs to maintain long-term research records can be substantially reduced. Through cooperative efforts we should extend the coverage of such research to include the major associations and conditions. Funding is a significant problem, but we need to start thinking about how to do it and where to do it. At the same time, we need to correct some inequities in the reward system for those engaged in long-term research.

For several years there has been a call for more multidisciplinary research. There may be some in the pipeline, but I have not seen much evidence that we can expect to see estimates of multiresource outputs designed specifically for that purpose. As we take on the more complex job of studying forest ecological processes, we must use multidisciplinary teams to evaluate multiple resources. Many central hardwoods owners and managers have multiple objectives. So far, we can only guess at or synthesize outputs other than timber. Considering the possible permutations that could result from various sites, types, ages, and stand conditions we may never be able to make finite estimates of multiple resources. But it certainly makes more sense to use appropriate expertise when a study is designed and executed.

In discussions of research needs, someone always recommends that we need to be able to prescribe some extensive treatments. This is good advice considering the long periods of investments and the relatively low timber value of many hardwood stands. We do need low-cost treatments to establish desirable regeneration, to favor the best species in young stands, and put the growth potential on the most valuable trees. Biological alternatives must be accompanied by valid costs and returns.

There are a lot of other technical areas with high priority problems that need to be solved before we make the central hardwood region fully productive for multiple uses. Without more effective utilization and better markets we will not be able to use the vast amount of excellent wood and fiber in low value trees that could be converted into high quality parts or products. This will require a lot of research and development in logging, processing and economics. How can we capitalize more on potential international markets while we strengthen the domestic industry? We still have a lot to learn and better guidelines to develop for both natural and artificial regeneration for many of the hardwood species. We will continue to lose and fragment forest acreages and habitats to stripmining unless we can make a better case for reclamation with trees. We have a

good foundation in growth and yield research, but we need to include more sites, species, quality, and time in our studies. Insects and diseases will be here as long as we have trees, and we need to know how to manage stands that are healthy enough to withstand the rigors of outbreaks that are sure to come. If we don't hurry up and learn to use fire as a cultural tool, we will lose it as an option. We know that timber cannot bear all the costs of ownership. We need better prescriptions for integrated management based on multidisciplinary research that will increase the quality and quantity of recreation, wildlife, and water as well as wood products. And owners and users tell us that is what they want.

That sounds like more than enough for all of us to do for quite awhile. That is why it is important to select high priority problems, get all the help you can, don't duplicate, and don't dally.

AND THAT'S NOT ALL

As Yogi said, "It ain't over till it's over." You are not done with your research until it is put into practice. Getting research results into use by individuals and agencies is a significant part of your job or at least it should be. There is another very good reason to get your research results applied--self preservation. Nothing begets funding better than highly visible success.

While I am giving advice, I would like to add a few more things for each of you to consider and support:

1. We need to support a strong and viable domestic forest industry.
2. We need to improve habitats for both consumptive and non-consumptive forest wildlife.
3. We need to improve forest esthetics and recreation.
4. We need to protect forest water quality.
5. We need to help develop a stronger forest land use ethic with longer ownership tenure.

I hope I have not left you with any feeling of pessimism. On the contrary, I am optimistic. The central hardwood forests certainly look a lot better than 40 years ago. The forest survey data show tremendous inventory increases. True, it is harder to find the very big trees, but that too can change with more time. When we get done with all the jobs in front of us, the forest will have changed so much that future researchers will have a new set of problems and opportunities. And that is not to say we did our jobs wrong. It will be because we did our jobs right and kept the forest dynamic.

To close I would like to share with you the last stanza of Cleo Caraway's "Sacred Trust" that opens the Central Hardwood Notes.

"For those descended from the settlers
Of three hundred years ago,
All the plants and living kingdoms in the
regions of the hardwoods
Are a trust to be conserved,
To be improved, to be restored,
All the woodland populations are a trust to
be restored
For the peoples of our nation,
For the peoples of the world."

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